

SECTION 637 SIGNING

637.1 Description

- (1) This section describes furnishing and installing signs, of the type or types specified, on supports in place or erected under the contract.

637.2 Materials

637.2.1 Sign Base Materials

637.2.1.1 Aluminum Extrusions

- (1) Use the style of aluminum extrusions specified in the plans. The engineer will accept any shape reasonably close to the shape illustrated, with no interlocking arrangement, and conforming to the minimum weight requirements the plans specify. Use the same style and brand of extrusion required for all the work under the contract. Use aluminum extrusions conforming to ASTM B 221, alloy 6061-T6, 6063-T5, or 6063-T6.
- (2) Perform all shearing, cutting, punching, drilling, or other fabrication procedures on extruded panels before preparing the aluminum to receive reflective material.
- (3) The department will allow a maximum deviation from flat on the face of extrusions of 0.004 inches per one inch of extrusion width.
- (4) The engineer will not require sign edge molding.

637.2.1.2 High-Density Overlaid Plywood

- (1) Use base material conforming to the U.S. Product Standard PS 1 for construction and industrial plywood. Use material manufactured from a group 1 wood and conforming to the requirements for A-A or B-B high-density overlay exterior plywood intended for use in highway signs, and suitable for applying reflective sheeting to without further surface preparation other than as specified below in [637.3.2](#).
- (2) Make plywood sign panels from material not less than 5/8 inch thick, except that for signs with a face 2 feet by 2 feet or less with the horizontal dimension no greater than the vertical dimension, the contractor may use 1/2 inch thick material.

637.2.1.3 Sheet Aluminum

- (1) For this base material, use aluminum alloy 5052-H38 complying with ASTM B 209.
- (2) Ensure sign blanks are free from laminations, blisters, slivers, open seams, pits from heavy rolled-in scale, ragged edges, holes, turned-down corners, or other defects that might affect their appearance or intended use. Use blanks conforming to the Aluminum Association, Inc., requirements for commercial flatness and uniformity of thickness. Perform all shearing, cutting, and punching before coating and applying reflective or other surface material.
- (3) Ensure that the sheared edges of all sign blanks are straight and free from tears or raggedness. Round all corners unless the plans show otherwise. Ensure all punched or drilled holes are round; free from tears, raggedness, and distortion of the metal; and of the diameter and location the department's Standard Layout of Sign Blank Detail, A 5-3 shows.
- (4) Degrease, etch, and coat the sign blank on both sides with a chromate treatment conforming to ASTM B 449, class 2. Apply the coating to a mean thickness of 25 ton/ft².
- (5) For other than stop signs, furnish material that equals or exceeds the following nominal thickness for the indicated sign width:

WIDTH	NOMINAL THICKNESS
30 inches and under	0.080 inch
Greater than 30 through 36 inches	0.100 inch
Over 36 inches	0.125 inch

- (6) For stop signs, furnish material that equals or exceeds the following nominal thickness for the indicated sign size:

SIZE	NOMINAL THICKNESS
24 inches x 24 inches	0.080 inch
30 inches x 30 inches	0.100 inch
36 inches x 36 inches and larger	0.125 inch

637.2.2 Sign Face Materials

637.2.2.1 Standard Reflective Sheeting

- (1) Furnish standard reflective sheeting conforming to ASTM D 4956, type I, class 1 or 3 and having a durability as follows:
 - For orange and reboundable sheeting; 12 months.
 - For others; 24 months.

637.2.2.2 Type H Reflective Sheeting

- (1) Furnish type H reflective sheeting conforming to ASTM D 4956 type IV, class 1 and having a durability as follows:
 - For orange and reboundable sheeting; 12 months.
 - For others; 36 months.
- (2) If the manufacturer provides a warranty for the type H sheeting, turn the warranty over to the department.

637.2.2.3 Type F Reflective Sheeting

- (1) Furnish type F prismatic reflective sheeting with a minimum initial coefficient of retroreflection as follows:

MINIMUM INITIAL COEFFICIENT OF RETROREFLECTION in either cd/ft ² or cd/lx/m ²				
OBSERVATION ANGLE	ENTRANCE ANGLE	FLUORESCENT ORANGE	FLUORESCENT YELLOW	FLUORESCENT YELLOW/GREEN
0.2 deg	-4 deg	200	240	325
0.2 deg	+30 deg	92	150	205
0.5 deg	-4 deg	80	165	215
0.5 deg	+30 deg	50	75	110

- (2) Conform to the sheeting color chromaticity coordinates and luminance factors as follows:

SHEETING COLOR	CHROMATICITY COORDINATES								LUMINANCE FACTOR	
	1		2		3		4		MINIMUM Y	MAXIMUM Y _F
	X	Y	X	Y	X	Y	X	Y		
Orange	0.562	0.350	0.645	0.355	0.570	0.429	0.506	0.404	20%	10%
Yellow	0.557	0.442	0.498	0.412	0.438	0.472	0.479	0.520	35%	15%
Yellow/green	0.387	0.610	0.368	0.539	0.421	0.486	0.460	0.540	50%	20%

- (3) The department may require independent verification of the initial coefficient of retroreflection and sheeting color.

637.2.2.4 Type SH Reflective Sheeting

- (1) Furnish type SH reflective sheeting conforming to ASTM D 4956 class 1 and the following:
 - Durability: 12 months for orange and reboundable sheeting and 36 months for other types.
 - Coefficient of retroreflection and daytime luminance factor: equal or exceed the requirements for ASTM D 4956, type IX.
- (2) If the manufacturer provides a warranty for the type SH sheeting, turn the warranty over to the department.
- (3) The department may require independent verification of the initial coefficient of retroreflection and sheeting color.

637.2.2.5 Nonreflective Sheeting

- (1) Furnish nonreflective sheeting consisting of a flexible sign face material precoated with an adhesive and protected by a liner. Sheeting thickness, without the liner, shall be from 0.003 inches to 0.005 inches inclusive.
- (2) Provide test data showing that the sheeting has no appreciable shrinkage, discoloration, cracking, crazing, chalking, blistering, delamination, or loss of adhesion.

637.2.3 Sign Message Material

637.2.3.1 Demountable Route Markers

- (1) Provide demountable route markers for type I and type III signs fabricated in the shapes the plans show. For the base material, use aluminum at least 0.040 inch thick. Use a face material conforming to [637.2.2.2](#) and the route marker outline as the plans show. Stencil the numerals and letters with paste conforming to [637.2.3.3](#) below.

637.2.3.2 Type H Message Material

- (1) Unless the plans show otherwise, furnish and install demountable letters, numbers, symbols, and border for type I and type III signs fabricated from type H reflective sheeting on aluminum base material at least 0.040 inch thick.

637.2.3.3 Stencil Paste

- (1) Use a manufacturer-approved stencil paste for the type of face material applying it to.

637.2.3.4 Electronic Cuttable Overlay Film

637.2.3.4.1 General

- (1) Furnish transparent colored electronic cuttable film for shop application over reflective sheeting. Use overlay film from the same manufacturer and with the same warranty as the underlying reflective sheeting.

637.2.3.4.2 Performance Requirements

- (1) After overlaying, the composite shall conform to the same ASTM D 4956 color specification limits and daytime luminance factors applicable to an equivalent background sheeting material of the same color with no overlay.
- (2) Furnish film coated with a pressure-sensitive adhesive capable of adhering without using additional adhesive. Ensure that the protective lining for the adhesive is removable without soaking in water or other solvents.
- (3) Furnish film with a coefficient of retroreflection that equals or exceeds 70 percent of that required by ASTM D 4956 for similar colored retroreflective sheeting. For blue films, 55 percent or greater is acceptable.

637.2.3.5 Vandalism Sticker

- (1) Affix a vandalism sticker to the face of all type I, II, and III signs. The stickers are available at all department region offices.
- (2) Position the stickers on the signs according to the following procedures:
 1. Attach the sticker at the extreme lower left corner of all square or rectangular signs, horizontally and typically outside the sign border, or just inside the sign border if the space between the edge of the sign and the border is not sufficient to accommodate the sticker.
 2. On all signs of other shapes, for example stop, yield, and no passing zone pennants, place the sticker at the lowest edge or corner of the sign, parallel with the border or edge of the sign, and at the left corner or left side of the sign.
 3. On signs with a white border, place the sticker within the white border at the locations designated.

637.2.3.6 Sheeting Material Identification Code and Installation Date

- (1) Affix identification code and installation date stickers on the back of signs as follows:
 - On type I signs, in the lower right corner.
 - On type II and type III signs, in the upper right corner.
- (2) Obtain stickers from the department's sign shop located at:

3609 Pierstorff St.
Madison, WI 53704

637.2.4 Sign Mounting Hardware

637.2.4.1 Type I Signs

- (1) Connect individual aluminum extrusion panels together to form a completed sign assembly. For panel stitch hardware, use self-locking nuts, bolts, washers, and other hardware as follows:
 1. Stainless steel conforming to [513.2.2.5](#).

2. Aluminum that the panel manufacturer either supplies or approves.
- (2) Mount the sign assembly using aluminum post clips, stainless steel bolts with self-locking nuts, and a protective stainless steel flat washer against each post clip. Provide the following:
 1. Stainless steel bolts, nuts, and washers conforming to [513.2.2.5](#).
 2. Aluminum post clips conforming to ASTM B 221, alloy 6061-T6, or ASTM B 108, alloy 356.0-T6.

637.2.4.2 Type II and III Signs

637.2.4.2.1 Ground-Mounted Signs

- (1) Furnish components to attach signs to ground mounted wood or steel posts using hex head nuts and bolts, washers, and other steel hardware treated in one of the following ways:
 1. Hot dipped or mechanically zinc coated according to ASTM A 153, class D.
 2. Cadmium plated according to ASTM B 766 type III, class 12.
 3. Electrically zinc coated according to ASTM B 633, type III, SC 3.
- (2) Use only nuts and bolts manufactured with sufficient clearance to allow the nuts to run freely on the bolts after plating or coating.

637.2.4.2.2 Overhead-Mounted Signs

- (1) Furnish a sign mounting system from the department's approved products list.

637.2.5 Color

- (1) For sign face and sign message materials provide the color the plans show.

637.3 Construction

637.3.1 Definitions

- (1) Type I signs consist of guide signs having extruded aluminum base material, reflective backgrounds, and reflective demountable messages. They are ground mounted on steel posts and are used in unlighted overhead locations.
- (2) Type II signs consist of miscellaneous warning, regulatory, informational, and standard size guide signs, having sheet aluminum or plywood base material, and reflective or non-reflective backgrounds, and non-removable messages.
- (3) Type III signs consist of small guide signs having sheet aluminum or plywood base material, reflective backgrounds, and reflective demountable messages. If ground mounted, type III signs have wooden post supports.

637.3.2 Manufacture and Assembly

637.3.2.1 General

- (1) Manufacture signs to conform to the dimensions and details the plans show. Letter series refer to the standard series approved by the FHWA. Ensure that the corners of type I signs are square, but make the borders as the plans show.
- (2) Where the department uses the term "message" in these specifications or on the plans, it includes letters, numerals, symbols, and borders.
- (3) Furnish shop drawings for review before fabricating signs described in special plan details. For signs described in the standard plan details, those with the "Standard Sign" designation in the lower right corner, the department does not require shop drawings.

637.3.2.2 Preparing Sign Panels for Reflectorization

637.3.2.2.1 Aluminum Panels

- (1) If applying reflective sheeting to aluminum panels, prepare the panels as follows:
- (2) Perform the preliminary cleaning of the sign blanks by completely submerging them in a 3 percent solution of inhibited alkaline cleanser at 160 to 180 F for 3 minutes, followed by a thorough rinse in clean running cold water. Instead of this method the contractor may use a grease solvent, such as naphtha, provided it applies the cleanser according to the manufacturer's directions.
- (3) After this preliminary cleaning, immerse the panels for at least 3 minutes in a 6 percent to 8 percent solution of phosphoric acid at 100 F. Then rinse the panels in a spray of cold water, followed by immersing for one minute in circulating hot water at 180 F. Dry the panels with forced warm air.

- (4) If using extrusions, and the panel length prohibits total immersion, then the contractor may apply 6 percent to 8 percent phosphoric acid at 100 F to the surface by swabbing, brushing, or spraying, and allowing it to remain for 5 minutes, then remove the acid using a cold water rinse and dry with forced warm air.

637.3.2.2.2 High-Density Overlaid Plywood Panels

- (1) Ensure that the plywood blank surfaces are smooth, clean, and free from any oils, edge sealant, dust, or solvent. If the reflective sheeting manufacturer recommends, lightly sand the sign face surface then wipe with a solvent before applying the sheeting.

637.3.2.2.3 Handling Panels

- (1) If reflectorizing the surface of aluminum or plywood sign blanks, handle the surface with devices or clean canvas gloves between all cleaning and etching operations and when applying the reflective sheeting.

637.3.2.3 Applying Reflective Sheeting

- (1) Prepare sign panels and blanks as specified above and according to the reflective material manufacturer's recommendations. Apply reflective sheeting according to the manufacturer's recommendations.
- (2) After curing for 48 hours at 70 F, the bond between the reflective sheeting and the sign panel or blank must resist stripping from the panel with a stiff putty knife; and must withstand 8 hours of soaking in water at 75 F without appreciable loss of adhesion.
- (3) Ensure that no line of separation exists between adjacent panels due to lack of reflective material. The contractor shall not extend the reflective sheeting from one panel to adjacent panels.

637.3.2.4 Applying Messages on Type II Signs

637.3.2.4.1 Signs with Black or Dark Message on a White, Yellow, or Orange Background

- (1) Apply messages using either of the following methods:
 1. Use a silkscreen stencil process with a black or dark stencil paste of a type the manufacturer of the underlying reflective sheeting approves for that application.
 2. Cut message units from black or dark nonreflective sheeting and apply to the underlying reflective sheeting. For the message, use black or dark nonreflective sheeting units from the same manufacturer and with the same warranty as the underlying reflective sheeting.

637.3.2.4.2 Signs with White Message on a Red, Blue, Brown, or Green Background

- (1) Apply messages using any of the following methods:
 1. Individually cut the borders, letters, numerals, and symbols from white reflective sheeting and apply them to a background of colored reflective sheeting from the same manufacturer. Apply according to the manufacturer's recommended procedures.
 2. Use the reverse screening process with a transparent stencil paste applied to white reflective sheeting. Ensure that the resultant background is uniform and has the required background color. Use the brand of transparent paste that the reflective sheeting manufacturer recommends.
 3. Use an electronic cuttable overlay film shop applied over underlying white reflective sheeting. Apply according to the manufacturer's recommended procedures. Ensure that the resultant composite produces the required background color.

637.3.2.4.3 Signs with Yellow Message on a Brown Background

- (1) Apply messages using either of the following methods:
 1. Individually cut the borders, letters, numerals, and symbols from yellow reflective sheeting and apply them to a background of brown reflective sheeting from the same manufacturer. Apply according to the manufacturer's recommended procedures.
 2. Use the reverse screening process with an opaque stencil paste applied to yellow reflective sheeting. Ensure that the resultant background is uniform and has the required background color. Use the brand of opaque paste that the reflective sheeting manufacturer recommends.

637.3.2.5 Applying Clear Finish

- (1) If the reflecting material manufacturer recommends a clear finish, apply the finish to the face of the sign panel according to the manufacturer's instructions after applying the background reflectorization to type I and type III signs, and after applying the background and message for reflective type II signs and allowing them to dry completely.

637.3.2.6 Applying Demountable Copy

- (1) Fasten demountable copy to type I and type III sign panels with aluminum rivets or aluminum self-tapping screws. Place aluminum rivets or aluminum self tapping screws at the ends and at 90 degree corners of all demountable copy legend, borders, arrows, and route markers. Space rivets or self tapping screws at a maximum of 6 inches on center. Do not install rivets or self tapping screws within 1 inch of extruded aluminum panel joints.
- (2) Use full standard length border sections, except if necessary to use less to fit a sign dimension. Make cuts, if required, as close as possible to midway between reflecting units. Fit the border units snugly together so no gaps are visible.

637.3.2.7 Assembling Type I Signs

- (1) For type I signs use aluminum extrusion sign base material.
- (2) Assemble individual aluminum extrusions into signs the size the plans show, according to the extrusion fabricator's recommendations and in a manner the engineer approves.
- (3) Make each extension the full width of the sign without joint or splice.

637.3.2.8 Assembling Type II and Type III Signs

637.3.2.8.1 General

- (1) For type II and type III signs, use sheet aluminum or high-density overlay plywood sign base material of the size and shape the plans show.
- (2) The contractor shall not use horizontal joints on a type II or a type III sign with a vertical dimension of 48 inches or less.
- (3) The contractor shall not use vertical joints on a type II or type III sign with a horizontal dimension of 144 inches or less. The contractor shall not use more than one vertical joint on type II signs.

637.3.2.8.2 Battens Over Joints

- (1) If using 2 or more sheets of sign base material to make a single type II or type III sign, then attach a 6-inch batten of the same material as the sign base by screws or rivets to the back of the sign and covering the joint.
- (2) Use screws to attach battens to plywood signs. Drive the screws into the sign from the back and do not cut the face of the sign. For screws or rivets exposed on the face of metal signs, use flathead, countersunk, or screws or rivets machined otherwise to produce minimal projection. Cover the screws or rivets with reflecting material the same color as the face of the sign at the point of exposure. For battens on plywood signs, the contractor may use one inch by 6-inch lumber pressure treated conforming to [507.2.2.6](#) using one of the waterborne preservatives specified in [507.2.3](#). Use battens that extend the full length of the joint, except stop horizontal battens within 10 inches of each sign post to allow mounting of the sign base material directly on the post, and stop vertical battens within 10 inches of all horizontal stiffeners or stringers to allow mounting the sign base material directly on them. Additionally, the contractor shall not use horizontal battens if locating a horizontal stiffener or stringer as specified below properly battens the joint.

637.3.2.8.3 Horizontal Stiffeners

- (1) Provide stiffeners made of 2 x 6 lumber pressure treated as specified for wood sign posts in [634.2.1\(3\)](#). Screw 2 horizontal stiffeners to the back of each type II or type III sign with one or more of the following:
 1. Vertical joints between adjacent panels of sign base material.
 2. Plywood base material and a horizontal dimension exceeding 80 inches and a vertical dimension less than 36 inches.
 3. Aluminum base material and a horizontal dimension exceeding 80 inches regardless of vertical dimension.

Horizontal stiffeners are not required for the following:

1. Signs mounted on bridges with either continuous bearing on the bridge or mounted on spacer blocks at both the top and the bottom of the sign.
 2. Signs mounted on horizontal stringers.
- (2) On plywood signs, drive the screws from the back of the sign and do not cut the face of the sign. For screws exposed on the face of metal signs use flathead, countersunk, or screws machined to produce a minimal projection. Cover the screws with reflective material the same color as the face of the sign at the

point of exposure. Position the center of the stiffeners 9 inches above the bottom of the sign and 9 inches below the top of the sign, respectively. Except on signs having a vertical dimension of 27 inches or less, then center only one stiffener on the back of the sign. Ensure that stiffeners extend the full length of the sign.

637.3.2.8.4 Horizontal Stringers

- (1) Mount signs on one or more horizontal stringers if the plans show. Each stringer consists of 2-inch by 6-inch lumber pressure treated as specified for wood sign posts in [634.2.1\(3\)](#). Attach each stringer firmly to the back of the sign and the supporting wood sign posts with bolts or lag screws as specified above for fastening signs to supports. If the sign is mounted on one or more posts, then fasten the sign, each stringer, and each post at their respective points of intersection by one or more bolts or lag screws passing through or into all 3 parts of the assembly. Ensure that stringers extend from the outermost post on one side of the sign to the outermost post on the other side of the sign and bear directly against the back of the sign.

637.3.3 Installing Signs

637.3.3.1 General

- (1) If erecting signs before their message becomes applicable, cover the face of the signs, in a manner the engineer approves, to make their messages unreadable during both daytime and nighttime. Maintain the covering in good condition until the message becomes applicable and the engineer orders the covering removed or until the contract expires.
- (2) Use a covering material sufficiently durable to withstand the effects of weathering, but also not damaging the reflective face of the sign, during the expected length of time the covering is needed. The contractor shall not apply any tape to the sign face in order to fasten the covering material.
- (3) The contractor shall not install stop signs and yield signs before the time that they are applicable.

637.3.3.2 Placing and Orienting

- (1) Establish and stake, or mark on the pavement, the longitudinal location of each sign, including signs on the main line roadways, frontage roads, ramps, and intersecting roads as the plans show or as the engineer directs.
- (2) Laterally position the sign from the shoulder edge or curb as the plans show or as the engineer directs.
- (3) The proper elevation, offset, level, and orientation of all signs erected are the contractor's responsibility. Exercise care to preserve all stakes. Reset all stakes lost, damaged, displaced, or removed, at no expense to the department.
- (4) Generally, erect all signs so the edge and face of the sign are truly vertical and the face is normal to the centerline of the roadway that the sign serves, and so the sign faces slightly away from the motorists line of sight in order to avoid specular reflection and glare.

637.3.3.3 Fastening Signs to Supports

- (1) If the plans require the contractor to mount signs on utility poles or highway lighting poles installed by others, then follow the method of mounting the plans show.
- (2) Fasten type II and type III signs to wood sign posts with bolts or lag screws. For signs with Type H or Type F Reflective Sheeting, place a fiber, nylon, or clear plastic washer between the head of the bolt or screw and the face of the sign. For all signs, place a metal washer on the bolt beneath the nut.
- (3) Fasten overhead-mounted type II and type III signs using a mounting system from the department's approved products list. Conform to torque limitations and other installation instructions provided by the sign mounting system manufacturer. Provide a copy of those instructions to the engineer.
- (4) Fasten signs to flanged beam sign supports and sign bridges according to the plans and the sign manufacturer's recommendations.

637.3.3.4 Performance

- (1) Under [105.11.2.4](#) the department may revoke acceptance and direct the contractor to repair or replace previously accepted sign installations if the department subsequently discovers evidence of defective materials or improper installation. Deficiencies that warrant department action include but are not limited to the following:
 - Sign posts more than five degrees out of plumb.
 - Signs twisted by more than five degrees from plan orientation.

- Signs with bubbling, fading, delaminating, or buckling surfaces.

637.4 Measurement

- (1) The department will measure the Signs bid items by the square foot acceptably completed, measured as the area of sign face for individually mounted signs and the area of the entire base panel for multiple signs mounted as an assembly.

637.5 Payment

Revise 637.5(1) to add bid items folding signs.

- (1) The department will pay for measured quantities at the contract unit price under the following bid items:

<u>ITEM NUMBER</u>	<u>DESCRIPTION</u>	<u>UNIT</u>
637.0100 - 0199	Signs (type)	SF
637.0200 - 0299	Signs Reflective (type)	SF
637.0300 - 0399	Signs Non-Reflective (type)	SF
637.0400 - 0499	Signs Reflective Folding (type)	SF
637.0500 - 0599	Signs Non-Reflective Folding (type)	SF

- (2) Payment for the Signs bid items is full compensation for providing all materials; for manufacturing and assembling the sign, including all messages; for hauling, handling, and installing the sign, including fasteners, necessary hardware, and vertical supports and U-bolts; and for replacing all stakes lost, damaged, displaced, or removed.
- (3) The department will pay for required sign supports, sign bridges, and electrical cable, under the appropriate bid item or items of the contract.